WHAT IS CLAIMED IS:

1.   A minute sample processing apparatus, comprising:

a focused ion beam optical system provided with an ion source, a lens for focusing an ion beam and an ion beam scanning deflector;

an electron ion beam optical system provided with an electron source, a lens for focusing an electron beam and an electron beam scanning deflector;

a detector for detecting a secondary particle discharged from a sample; and

a sample stage on which said sample is placed, wherein there are provided

a probe for supporting a minute sample which is cut out by applying the ion beam to said sample; and

a mechanism for operating said probe so that a section of said cut-out minute sample becomes substantially perpendicular to an optical axis of said electron beam.

2.   A minute sample processing apparatus, comprising:

a focused ion beam optical system provided with an ion source, a lens for focusing an ion beam and an ion beam scanning deflector;

an electron ion beam optical system provided with an electron source, a lens for focusing an electron beam and an electron beam scanning deflector;

a detector for detecting a secondary particle

discharged from a sample; and

a sample stage on which said sample is placed, wherein there are provided:

a probe for supporting a minute sample which is cut out by applying the ion beam to said sample; and

a moving mechanism for moving said probe.

3.   The minute sample processing apparatus according to claim 2, wherein said moving mechanism has a function of adjusting a position and an attitude of the minute sample with respect to the ion beam or election beam.

4.   The minute sample processing apparatus according to claim 2, wherein said moving mechanism comprises a function of controlling an application angle of the ion beam or election beam to said minute sample.

5.   The minute sample processing apparatus according to claim 3, further comprising a second sample stage capable of mounting on a plurality of minute samples conveyed by said moving mechanism, said second sample stage comprising a rotating mechanism for changing the application angle of the ion beam or electron beam to said plurality of minute samples.

6.   The minute sample processing apparatus according to claim 2, further comprising a detector for detecting an X-ray generated from said sample or minute sample resulting from application of the electron beam.

7.   The minute sample processing apparatus

according to claim 2, further comprising a mechanism of changing an angle of said focused ion beam optical system.

8.   A minute sample processing method for observing a section of a sample using a minute sample processing apparatus which comprises a focused ion beam optical system provided with an ion source, a lens for focusing an ion beam emitted from said ion source and a scanning deflector for scanning with the ion beam emitted from said ion source; an electron ion beam optical system provided with an electron source, a lens for focusing an electron beam emitted from said electron source and a scanning deflector for scanning with the electron beam emitted from said electron source; and a vacuum container on which said focused ion beam optical system and electron beam optical system are mounted,

wherein the method comprises the steps of:

cutting out a minute sample from said sample by applying a focused ion beam to said sample;

lifting said cut-out minute sample from said sample using a probe;

changing attitude of said minute sample by operating said probe with a condition that said minute sample is being lifted; and

applying the electron beam to a section of said minute sample with a condition that the attitude of said minute sample is changed,

said steps being carried out in said vacuum container.

9.   The minute sample processing method according to claim 8, wherein said step of changing the attitude of said minute sample comprises controlling said probe so that the section of said minute sample becomes substantially perpendicular to an optical axis of the electron beam.

10.   The minute sample processing method according to claim 8, wherein a shape of said minute sample is tetrahedron or pentahedron.

11.   The minute sample processing method according to claim 8, wherein said sample is a semiconductor wafer with or without pattern.

12.   A minute sample processing apparatus, comprising:

a vacuum container;

a sample stage for placing a sample in said vacuum container;

a charged particle source;

an application optical system for applying a charged particle beam from said charged particle source to the sample;

a secondary particle detector for detecting a secondary particle generated from the sample by application of the charged particle beam;

a needle member whose tip can be brought into contact with the sample;

a probe holder for holding said needle member;

an introduction mechanism capable of introducing and extracting said probe holder into and from said vacuum container; and

a moving mechanism having a structure of slanting said probe holder to a surface of said sample stage.

13.   A minute sample processing apparatus, comprising:

a vacuum container;

a sample stage for placing a sample in said vacuum container;

a first charged particle source;

a first application optical system for separating part of a sample on said sample stage with a charged particle beam from said first charged particle source;

a needle member for extracting the separated sample piece;

a probe holder for holding said needle member;

a second charged particle source;

a second application optical system for applying a charged particle beam from said second charged particle source to the sample piece attached to said probe holder or the sample on the sample stage;

secondary particle detecting means for

detecting a secondary particle generated by application of said first or second charged particle beam;

a moving mechanism having a structure of moving said needle member in said vacuum container and inclining said needle member to a surface of said sample stage; and

introduction means for introducing and extracting said probe holder into and from said vacuum container.

14.   The minute sample processing apparatus according to claim 13, wherein said first charged particle source and said first application optical system, and second charged particle source and said second application optical system are relatively disposed in a slanting manner to a sample placing surface of said sample stage.

15.   A minute sample processing apparatus, comprising:

a vacuum container;

a sample stage for placing a sample in said vacuum container;

a first charged particle source;

a first application optical system for separating part of a sample on said sample stage with a charged particle beam from said first charged particle source;

a needle member for extracting the separated sample piece;

a first probe holder for holding said needle member;

a second probe holder for taking the extracted sample piece out of said vacuum container;

a second charged particle source;

a second application optical system for applying a charged particle beam from said second charged particle source to the sample piece attached to said first probe holder, the sample on said sample stage or a sample piece on said second probe holder;

secondary particle detecting means for detecting a secondary particle generated by application of said first or second charged particle beam;

a moving mechanism having a structure of moving said first and second probe holders in said vacuum container and inclining said first and second probe holders to a surface of said sample stage;

a first introduction part capable of introducing and extracting said first probe holder into and from said vacuum container; and

a second introduction part capable of introducing and extracting said first probe holder into and from said vacuum container.

16.   A minute sample processing apparatus, comprising:

a vacuum container;

a sample stage for placing a sample in said vacuum container;

a charged particle source;

an application optical system for applying a charged particle beam from said charged particle source to the sample;

a secondary particle detector for detecting a secondary particle generated from the sample by application of the charged particle beam;

a needle member whose tip can be brought into contact with the sample; and

a cover member for protecting said needle member disposed within a movement range of said sample stage, said cover member having a structure inclined to a surface of said sample stage.